# SPECIFICATION

## TITLE OF THE INVENTION

Title: Weight-Bearing Support Insole with Four Varying Degrees of Arch

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## CROSS-REFERENCE TO RELATED APPLICATIONS

| Application #: | Filing Date: | Inventor: | U.S. Class: |
|---|---|---|---|
| 405147 | March 1995 | Chambers | 36/44 |
| 494657 | January 2000 | Maki | 36/40 |
| 573341 | May 2000 | Erickson | 36/100 |
| 586654 | June 2000 | Brown | 36/44 |
| 766964 | January 2001 | Dieckhaus | 36/44 |
| 028291 | December 2001 | Erickson | 36/100 |

## STATEMENT OF FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not Applicable

## REFERENCE TO SEQUENCE LISTING

Not Applicable

BACKGROUND OF THE INVENTION

(001) It is noted that many educated men believe that a foot can be comforted by being placed upon a cushion insole. It would make sense to think that a softer more "cushiony" foot bed would be more comfortable, but in fact, upon weight-bearing, the cushion is compressed greatest. Therefore, the point of greatest compression in the foot bed is the point of greatest pressure, which is exactly the opposite of the desired result. Our weight-bearing concept of support and comfort is based on firm, and flexible support. After the brain, the foot is the most architecturally and functionally complex part of human anatomy.[1] It consists of 26 bones, 33 joints, 112 ligaments, three arches, 4 layers of tissue on the sole of the foot, 20 intrinsic muscles, and the most likely ligaments of the human body to be sprained. In order to effectively eliminate foot and leg ailments solid support and correct positioning of the three arches (arches are curvatures or voids in the foot bed) need to be addressed. This firm yet flexible support and corrective positioning is required to help distribute weight and motion evenly over the entire foot structure, and in turn will provide maximum comfort and health throughout the entire body.

(002) While it is commonly believed that the insole with the most cushion and softness is the best type, they have proven less than ideal in several aspects. The foam material that makes up most insoles-intended to primarily cushion the foot typically lacks strength and firmness to provide necessary support for the proper biomechanical functions of the foot. This in turn concludes that these low quality 'cushioning' insoles only offer temporary relief at an inexpensive cost.

(003) On the opposite end of the arch/foot support spectrum, is custom orthopedic supports made by doctors especially for individual patients. These orthopedic supports are made primarily of a hard, unbendable thermal plastic that provides a *hard* heel area and a high medial arch that stops at the metatarsal/mid foot area, offering little to no lateral support for equalizing balance. These custom orthopedic supports are extremely expensive making them accessible to only a small target market, primarily consumers with insurance that covers the costs and are extremely unusable by athletes due to the hard unbendable material.

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[1] Fact found at: http://www.biotone.com

(004) In reviewing the foregoing material, it becomes desirable to enter this insole market with a new product. This weight-bearing insole support system will target the largest consumer segment in the current and stagnant insole market. By producing a semi-rigid insole addressing all three arches, including four VARYING DEGREES OF MEDIAL ARCH[2], and a deep heel-cup offering maximum support, made of higher quality materials that will be longer lasting, and sold at a moderate price level-targeting a greater market, will create a permanent relief and a corrective product for foot ailments. These semi-rigid weight-bearing insoles will allow controlled movement of the subtalar joint and, therefore, provide a balanced shock-absorption for the entire foot.

## BRIEF SUMMARY OF THE INVENTION

(005) The essence of this invention is the creation of a biomechanically shaped, weight-bearing support insole, which is applied into the interior of any shoe or boot in which will cooperatively support all three arches of the foot: the medial longitudinal arch, the transverse or metatarsal arch, and the lateral longitudinal arch, as well as the heel. Because of the arches, weight is not distributed evenly across all the bones of the foot. There are six bones sharing the body's' weight and seven points of contact/weight distribution (1 calcaneus, 4 lateral metatarsals, 2 sesamoid bones.)

(006) There are hundreds of different foot shapes among the human species and all are made with the same basic structural make-up. However, the area of each foot that varies considerably from person to person is the medial arch (also called the dynamic arch). The medial arch goes downward to absorb weight and springs back up to return energy to the lower limb during walking. The chief characteristic of this arch, and the primary reason that it is our main focus is its elasticity, due to its height and to the number of small joints between its component parts.

(007) This weight-bearing support insole's PRIMARY FOCUS and ATTRIBUTES revolves around the MEDIAL ARCH. It will be produced in four varying medial arch degrees that provides a unique weight-bearing corrective support offered by

[2] Not yet seen in any market.

no other competitors in the current market. These four varying medial arch degrees helps prevent, when properly fitted will distribute weight-generated forces into a neutral plantigrade position. The neutral position obtains maximum support provided by the correct level of arch for the individual user's foot. The insole will evenly distribute body weight over the entire foot providing permanent relief, and will correct current foot, back and neck pain. The medial arch of the insole will also change in length as the size of the insole changes, allowing for a more correct fit.

(008) The LATERAL LONGOTUDINAL ARCH will be supported by a substantially rigid outer support wall, which extends generally upward along the lateral side portion of the foot having a STANDARD DEGREE OF HEIGHT RELATIVE TO THE MEDIAL ARCH and length of the insole. With the high medial arch provided by this insole, the outer lateral support wall will help eliminate supination (turning of the foot outward) of the foot, control motion, and allow the foot to balance equally, causing little to no stress on the foot and/or ankle, muscles and ligaments.

(009) The TRANSVERSE (metatarsal) ARCH of the foot will be supported by this insole support system with a substantially rigid, upward support in the metatarsal portion of the foot. The circular, tear shape of the transverse arch support will provide support by distributing pressure more evenly on the forefoot and toes. The transverse arch has the characteristics of a 'hemi-arch' or half-domes which are directed downward and medial-ward, so that when the medial borders of the feet are placed in apposition a complete tarsal dome is formed. With the incorporation of the transverse arch, weight will be distributed more evenly over the metatarsal bones of the forefoot.

(010) Commonly, these arches do not vary as much as the medial arch therefore will be given a standard degree of height according to the size/length of the insole. The transverse (metatarsal) and the lateral arch supports are extremely hard to find, and are very inadequate in the competitors' products. Our weight-bearing insole support system will allow proper juxtaposition to all arches of the foot by providing a biomechanically shaped surface for the foot-bed.

(011) The HEEL is an extremely important part of the foot that is normally overlooked when creating comfortable and supportive insoles. To understand the shape

of the heel, and the amount of support that is needed to control excess motion is to imagin ach heel as a tennis ball. When a tennis ball is laid on a flat surface only the very bottom of the ball has contact with th surface, allowing the ball to mov and roll freely. This also means that the entire weight of the ball is putting pressure on that single point of contact.

(012) The theory of the tennis ball on a flat surface is the same as a heel in an average shoe or insole. The support that is provided by the current products in the market have little to no heel support, which allows only a small percentage of the heel to have contact with the surface at one time. Most insole manufactures address this discomfort with padding, not support. Our insole design provides a weight-bearing *deep* heel-cup that has contoured walls circling the entire heel creating a larger surface area of contact, which will in turn distribute the initial impact of weight over a greater surface area providing more comfort and support to each step.

(013) Foot experts and consumers will value the creation of this versatile insole product that has the capability to accommodate most every type of foot[3] size and shape, which will also fit into most shoe styles and sizes. In addition the insoles will be made in both men's and women's sizes offering a more custom fit to each individual consumer.

(014) This weight-bearing support insole has unique support offered by no other competitors. It has the ability to provide permanent relief, not just temporary relief to our consumers. Our product will be helpful in effectively eliminating current arch, foot, back, and neck pain by correctly supporting the foots main attributes with solid flexible support.

[3] This particular support may not be suitable for 'flat footed' or deformed feet.

BREIF DESCRIPTION OF THE DRAWINGS

(015) To facilitate the understanding of the characteristics of this invention, the following drawings have been provided wherein:

FIG. **1** is a perspective view of the Low Arch Height weight-bearing support insole showing an elevated view from the medial side of the insole, for use in the left shoe;

FIG. **2** is a perspective view of the Medium Arch Height weight-bearing support insole showing an elevated view from the medial side of the insole, for use in the left shoe;

FIG. **3** is a perspective view of the High Arch Height weight-bearing support insole showing an elevated view from the right side of the insole, for use in the left shoe;

FIG. **4** is a perspective view of the Extreme Arch Height weight-bearing support insole showing an elevated view from the right side of the insole, for use in the left shoe.

FIG. **5** is the graph and the adopted algebraic equation of ARC = angle of $\ell$ for finding the LOW medial arch degree in a shoe size 8.

FIG. **6** is the graph and the adopted algebraic equation of ARC = angle of $\ell$ for finding the MEDIUM medial arch degree in a shoe size 8.

FIG. **7** is the graph and the adopted algebraic equation of ARC = angle of $\ell$ for finding the HIGH medial arch degree in a shoe size 8.

FIG. **8** is the graph and the adopted algebraic equation of ARC = angle of $\ell$ for finding the EXTREME medial arch degree in a shoe size 8.

DETAILED DESCRIPTION OF THE INVENTION

(016) In our every day lives there are hundreds of thousands of forces that are pulling, pushing, and tugging at us in every direction. These forces work to produce curves of arches and angles in every activity that we conduct. For example, standing still on your feet. There's no *net* force in this activity, since you stand still, but there *are* forces, which balance each other out: your weight, and the force of gravity, pushing you down. Versus the restoring force of your shoe supports, compressed by your weight and trying to spring back, pushing you up.

(017) The two forces are equal and opposite, canceling each other out as you just stand there, unaware of all unforeseen forces. However, your body day after day, year after year, are taking a toll and paying for these forces. What this insole invention will do is provide proper weight-bearing arch support under the feet to contour the foot and lessen the forces of everyday standing, walking and running activities.

(018) There are *hundreds* of different foot shapes and sizes among the human population; the majority of this population is not properly supporting this intricate structure of bone, ligaments, and muscles. Through numerous studies, it has been determined that significantly more support needs to be placed under the bed of the human foot. With four varying degrees of medial arch support this insole support system will allow the proper levels of support for each of the particular arch degree categories that have been determined. Below is a detailed description of each arch type and how it will benefit the individual consumers.

(019) LOW ARCH HEIGHT (degree) – The low-arched foot is characterized by a lowering and flattening of the plantar aspect and an excessive eversion of the foot, which often indicates an over pronated foot. Over pronation is a foot that sinks down on the outside of the heel and rolls inward to the medial arch. This arch support system for this low degree of height will focus on providing motion control, stability, and a minor medial arch. The motion control and stability factors will help control the over pronation. Also, the low medial arch will allow for greater weight distribution, providing the consumer with much more support and total body comfort than any other product on the current market.

(020) MEDIUM ARCH HEIGHT – The medium-arched foot group makes up the majority of medial arch heights, making the Medium Arch Height one of the most significant arch degrees offered. The medium-arched foot normally strikes on the outside heel, then rolls inward slightly to absorb shock (pronation). This inward motion is the exact point that at which the medial arch needs the proper arch height to support and distribute weight-generated forces into a neutral plantigrade position. This weight-bearing arch support's medial arch angle will be substantially larger and more rigid than any other current market products.

(021) HIGH ARCH HEIGHT– The high-arched foot is characterized by plantar flexion of the forefoot, and inversion of the rear-foot. A high-arched foot is generally defined as an underpronated or supinated foot. This high-arched foot strikes the outside heel and will have little to no inward roll, positioning body weight primarily on the lateral side of the foot. By filling the arch void under the foot with a high arch degree we will create a greater surface area of contact for the foot. By researching products on the current market, it has been concluded that there is insufficient medial arch support for consumers who fall into this target area. This weight-bearing support insole will be a drastic change and foreign at first, but consumers will soon notice total body improvements.

(022) EXTREME ARCH HEIGHT – The extreme-arched foot is defined as an extremely supinated foot with extreme plantar-flexion. The consumer with this type of arch distributes their body weight on the outside (lateral) side of the foot. An extremely high degree of weight-bearing medial arch is necessary to allow for an equal weight distribution over the entire foot. This target market will find this weight-bearing support insole extremely beneficial to their entire body.

(023) This weight-bearing support insole's primary focus and attributes revolves around the medial arch. The medial arch goes downward to absorb weight and springs back up to return energy to the lower limb during walking. The chief characteristic of this arch, and the primary reason that it is our main focus is its elasticity, due to its height and to the number of small joints between its component parts. To support the essence

of this invention, the four degrees of medial arch support, we have adopted the algebraic equation of ARC = angle of $\ell$.

(024) The equation that was adopted to derive the degree of each arch consists of two variables:

X = Length of the arch (fixed for each individual insole size)

H = Height of the arch (four different heights of H for each size)

(025) With this equation we have adopted, particular degrees of medal arch for each run of shoe sizes for both men and women. By creating four unique degrees of medial arch support that configures cooperatively to low, medium, high, and extreme degrees of individual user's arch needs will distribute weight-generated forces into a neutral plantigrade position. These degrees will be in turn a variable fit to each consumer's particular arch by having the ability to choose from four different dynamic arch degrees. The table represented in figure 5, is of only one size of insole, meaning the length of the arch is consistent between the four different degrees. This allows one consumer to try each arch height to determine which height best fits their individual foot.

(026) The graphs represented in figure 6, are representations of the mathematical equation of finding the degree of height for each insole size. Please refer to the graphs and equations in figure 6 for estimated examples for the arch sizes for a man's shoe size 11.[4] The portion of the circle that is created by this equation (bold) is the actual height/ curve/ degree of angel that will create the medial arch in this weight-bearing support insole.

[4] The numbers present are rough estimates on the data that has been thus far collected from research. May be subject to vary prior to production.